A Comparative Study of Different Cloud Services, Cloud Security Issues and Cloud Providers

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Abstract: Cloud computing is the most emerging field in the field of computing. But selecting the right cloud service provider to trust with your infrastructure, critical applications and sensitive data can be a difficult process. In this research paper various cloud services along with the related cloud security issues has been discussed and analysed. Also a comparison of three major cloud service providers namely Amazon AWS, Windows Azure and Google App Engine have been carried out in terms of the service and security issues. It will help the consumers of cloud services to choose the right cloud provider according to their requirements and needs.

Keywords: Cloud, Select, Choose, Security, Amazon, Windows Azure, Google App Engine

I. INTRODUCTION

Cloud computing permits hardware and software to be provided as services, where the term service is used to produce the fact that they are provided on demand and are paid on a pay per usage basis, like you use more, more charges are applicable. Draw a likeness with a cafeteria. This provides a foodstuff and drinks services. If we would like to eat at a restaurant, we do not need to buy it before, just use it as we require. As much you'll eat accordingly you have to pay. Cloud Computing delivers computing services in the same way as restaurants deliver foodstuff, when we need computing services; we'll use them from the cloud. The more we use the services more we have to pay. When we stop using the services we stop paying for those services.

SaaS is typically an end user applications provided on demand over a network on a pay per use basis. The software installation on client side is not required, web browser and internet connection is only required. For example, SaaS is MS Office365. Until it is launched, if a user needs some software application, say Microsoft Word, they would have to buy, install the same and backup files etc. manually. But with Office365 Word, it can be acquired for small monthly charges, with no client installation, the files are backed up automatically, software upgrades are automatically provided and the software can be accessed from anywhere. Suppose you do not need Word anymore, stop paying the monthly charges. PaaS used by software development organizations to run their s/w products. Software products needphysical servers on which you can run it, with database software, often Web servers also. These are the platforms upon which the application will run. Building this yourself is a time intense process and needs to be frequently monitored and updated. PaaS provides all of the platformsout of the box enabling s/w applications to be given to the platform which will execute them with no need of administration of the lower level mechanisms. IaaS has a wide range of features, from distinct servers, to personal networks, disk drives, various non-volatile storage devices as well as email servers, DNS and the messaging systems. All of these can be provisioned on demand and must have license fees for operating systems and related software installed on the servers. Organizations can build a complete computing infrastructure by using IaaS as demanded.

So all the services provided by Cloud Computing fit into one of the three delivery models above. End users typically use SaaS, software development teams PaaS and IT departments whose responsibility is the infrastructure use IaaS.

There is much more to Cloud Computing, including aspects such as the automatic scaling and security for example, but as a starting point, categorizing the delivery models should help to understand that all aspects of computation are covered and it can be very useful for everyone whotangled in it.

Inthis section, we'll discuss a few cloud computing services of each type to achieve an overview of the presentservices. Existing taxonomies [1] and associated work have been well thought-out to make a selection of the presentcloud computing services for this overview [2]. As furthersource of information is cloud services websites havebeen referred to provide more information on the service. Furthermore these cloud services are described in the next sections.

II. INFRASTRUCTURE AS A SERVICE

A cloud infrastructure service providesa virtualization platform that is an advancement of the virtual privateserver providing that are already known for years [3]. Thecustomers prefers to buy the resources, rather of having set up'sservers, software, and data centres space themselves, and getbilled based on the resources consumed. They provide theirown software on the virtual machines and manageits control virtually. The virtual illustrations can be rented on necessity basis. The amount of instance scan be scaled dynamically to fulfil the customers'needs. Billing is based on this amount, the duration, and additional services used, such as additional storage space etc. Providers often have data centres in multiple locations to offer quick access all over the world. Web interfaces allow monitoring of the cloud service. Some providers make it possible to connect the virtual instances to the company's network via VPN (Virtual Private Network), to make the company network seem like one big scalable IT infrastructure. These solutions are called hybrid clouds, as they connect the company's (internal) private cloud with the public cloud of the IaaS provider [4].A pioneer in virtualization and computing power offerings is Amazon. The Amazon Elastic Compute Cloud (EC2) is one of the most widely used infrastructure platforms [5]. Further popular virtualization services include Serve Path's Go Grid [6] and the Rack space Cloud [7].Other services are the IBM Smart Business cloud solutions, Oracle Cloud Computing, Giga Spaces, Right Scale and Nimbus. Online storage and backup services fall in the category of IaaS. Like most virtualization platforms, there are several storage solutions intended for corporate use, but there are also special services for private individuals. Corporate services range from temporal to permanent and from generaladditionalstorage space to extend the company's internal capabilities, to storage services aimed at database-structured information. These latter services are billed based not only on the amount of storage space used, but also on the amount of queries on the data. Further, there are specially designed services to extend the storage amount offered with standard virtualization instances. For individuals who are taking service of private cloud, more and more cloud storage space and backup services are provided. Personal computer and netbook producers and operating system providers advertise for additional web-space. You can store data on the provider's servers for backup or to synchronize numerous terminals and can be recalled from different locations, as the services are often reachable also with a web-browser, such as Rackspace's Cloud Files [7].Rackspace provides online storage for corporate and private uses. Another storage provider is Nirvanix [8]. Amazon offers data storage services either in amalgamation or different from their EC2 instances, called Amazon Elastic Block Store (EBS) and Amazon Simple Storage Service (S3), respectively. Amazon also provides special database solutions, such as the Amazon Simple DB [9].

III. PLATFORM AS A SERVICE

PaaS providers offer a fared, managed and higher level software infrastructure, where cloud users can build and set up particular classes of applications and services using the utilities, platforms, environments and programming languages supported by the cloud provider. The offers include the use of the underlying infrastructure, such as computing servers, computer network, storage space or operating systems, over which the cloud consumers do not have any control, as it is inattentive away below the platform [67].

Platform services are mostly targeted at particular fields and domains, such as the development of software, web based applications, and are programming language dependent. Cloud users get an isolated environment to test and develop their applications on the cloud provider's platform. Google's App Engine is aimed at conventional web applications offering a Java or Python environment [10]. For lesser no scaling applications, the Google App Engine provides its service free of cost. Azure platform is provided by Microsoft, where applications can be developed and deployed using the .NET libraries [11]. Microsoftpractises their cloud offers to endorse their own software packages [1].Force.com is an example of Platform as a Service (PaaS) of a different domain. Force.com allows companies to develop tailored business applications, like to the services being offered by Salesforce.com.

IV. SOFTWARE AS A SERVICE

In SaaS, Software services are provided by the cloud providers. Cloud software offerings as SaaS generally provide precise and specific already developed applications running on the cloud infrastructure at cloud provider's site. A

very renowned example ofSaaS is the web-based e-mail facility. Most of the softwarecloud services are web-based applications,which can be accessed through a web browser from various client devices through athin client interface. The cloud usersdo not manage the underlying services, infrastructure and application platforms. Only limited user specific configurations are provided to the end users. Salesforce.com services a software cloud service intended for corporate use which offers business scrutiny and analysis as well as customer relationship management (CRM) tools [12].Appian Anywhere is another domain specific SaaSwhich provides facilities ofbusiness process management utilities and tools [6]. Google Apps also provide popular softwareservices for private use. These include calendar reminders, contacts, webbased email,and chatting capabilities. It alsoprovides Google Docs package [10], which permits access and sharing of spreadsheets, files, documents and presentation files among the cloud tenants. Another document sharing and backup service is Box.net [7]. SmugMug is a SaaS provider which is intended for video and photo sharing. It uses Amazon S3 cloud for this purpose [13].

In the next section various characteristics specific to cloud services are described as follows:

1.IaaS-specific characteristics

IaaS Characteristics include support for operating systems, applications and frameworks, as this isrequired for potential cloud customers. Most of the IaaS cloud providers support Linux operating systems, but some cloud providers also havesupport for windows and Open Solaris operating system. Extensively supported applications are Apache HTTP Server and the MySQL database software.Another property that is key for software developers is the kind of development tools the provider supplies. It could include an API or special commandline tools [14]. Services including virtual instances can beadditionally differentiated based upon the virtualization technologybeing used. Xen is currently used by most of the cloud service providers [14].In this cloud service delivery model, the provider facilitates the ability to clients for data processing, storage space, networks and other fundamental computing resources on provisional basis where the cloud customers are capable to deploy and run different software's that include operating systems and various applications. IaaS provides a platform for enabling virtualization in the cloud environment as a service [15]. Clients have control over computer memory, central processing unit, internet protocol addresses, operating systems, storage space, deployed software applications and probably limited control of certain networking components e.g., client firewalls. End users do not manage or control the underlying cloud infrastructure [14]. In IaaS model, cloud providers delivers a trusted host and virtual machine monitoring environment for the clients. Amazon EC2 and S3, Sun Microsystems and Dropbox are example of IaaS providers[10].

2.PaaS-specific characteristics

Support for programminglanguages and environments is a significant platform-level characteristic.For example, Google's App Engine currently onlysupports Python and Java environments. Another characteristics are supported operating systems and applications. In the PaaS model, cloud provider facilitates the cloud customers with the programming language platforms and software applications such as Java, Python or .Net to deploy their own developed or acquired applications on the cloud provider's infrastructure over the internet with Application Program Interfaces (APIs) or web browsers [14]. PaaS providers assist many services for application developers such as virtual development environment, application standards based on the developers' needs and requirements, configured toolkits and utilities for the virtual development environment and convenient distribution channel for public software application developers [10]. Cloud customers have control over the applications provided by cloud providers and probably application hosting environment configurations. Cloud clients do not have control over the core cloud infrastructure including network, cloud servers, operating systems or cloud storage space [14]. In PaaS model, it's the cloud provider's liability to protect the computing platform and development environment, while the cloud clients have to secure their applications themselves [16]. Google App Engine, Force.com and Microsoft Azure are the example of PaaS providers.

3.SaaS-specific characteristics

Software cloud services differ a lot from IaaS and PaaS. One of the characteristic to be considered is the client and application domain of the offered service. This domain may be client relations or other business management zones, office applications, social networking, and data interchange. In SaaS model, cloud provider provides the clients licensed applications running on a cloud infrastructure through a web browser interface over the internet on pay-per-usage model. Customers need not to be manage the underlying cloud infrastructure including network, cloud servers, operating systems or storage space. Currently, SaaS is a perfect model to access the light weight software applications such as notepad, word processor, media content player etc. However when it comes to heavy weight software applications such as editing photos in Photoshop, playing online 3D games, the performance of SaaS may degrade due to buffering time. Examples of SaaS vendors are Zoho Suite, Apple's Mobile Me and Google Docs [17]. Usually the cloud service provider resides and maintains cloud users' applications on a particular virtual

machine specific to that cloud user in a virtualized cloud environment. Finally, summarization of the attributes of SaaS, PaaS and IaaS in the form of a table 1 which is presented in the table below:

Table I: Comparison of Cloud Service Models

Attributes	SaaS	PaaS	IaaS
Service providers	Salesforce.com, Office live, Google apps.	Azure, Google app. Engine, Netsuite	IBM, Microsoft, Google, Amazon
Application management	By the end user	By the application developer	By the vendor
Data management	By the end user	By the application developer	By the vendor
Runtime management	By the end user	By the vendor	By the vendor
Middleware Management	By the end user	By the vendor	By the vendor
Operating system management	By the end user	By the vendor	By the vendor
Services availability	24x7	24x7	24x7
Visibility	End users	Application developers	Network architects
Users	Business users	Developers and deplorers	System managers
Security	Prevents from replication of organization in the cloud	Protects private information from being sent to the cloud	Protects against rouge cloud usage
Virtualization Management	By the vendor	By the vendor	By the vendor
Servers management	By the vendor	By the vendor	By the vendor
Storage management	By the vendor	By the vendor	By the vendor
Networking management	By the vendor	By the vendor	By the vendor
Operating Environment	Operating environment is largely irrelevant and fully functional apps provided e.g. CRM(Customer Relation Management), E-mail,ERP(Enterprise Risk Management)	Total Operating environment is included e.g. Windows, .Net, Linux, J2EE	Virtual platform on which required operating environment and applications can be deployed and storage space.
Number of providers	Thousands of applications in the cloud.	Few cloud platforms.	Elite group of providers.
Types of Services	Dynamic infrastructure services	Integration as a service	Dynamic applications services

Movement of data	Content and business processes	Source code	Operating System or virtual machine
Client control	The client has limited control of user-specific app. Configuration settings.	The client has control over the deployed applications and configuration settings for the app. hosting environment	The Client has Control over o/s, storage and deployed applications.
Focus	Services consumer, applications including archive, backup, ecommerce, social media	Developers, development tools and environments, social media	Virtual resources, servers, storage, Networking, hardware and software services
Access type	One can use, access applications and storage facilities without having to download or manage software on your pc.	One can access tools to help write and deploy an application, based on technology owned and managed by someone else	One can use the storage, computer resources and networks owned and managed by someone else

V. COMPARISON OF CLOUD SERVICE PROVIDERS

There are a number of service providers for cloud computing such as Amazon's web services, Google's Application Engine, Windows Azure, Rackspace, Salesforce.com, IBM cloud solutions, Netsuite etc. as mentioned in the above table. Among these all, a comparative analysis of first three has been done and presented in the table 2 below:

Table II: Comparison of Cloud Service Providers

		Amazon AWS	Windows Azure	Google App Engine
Cloud Services		PaaS IaaS	• PaaS • IaaS	PaaS☐ SaaS
Platforms Supported		Red Hat Enterprise Linux Windows Server 2003/2008 Oracle Enterprise Linux Microsoft SQL Server Standard 2005 Fedora Gentoo Linux	Operating Systems: Windows 7 Windows 8 Windows Server 2008 Windows Vista	Java Runtime Environment Python Runtime Environment
Language Supported		Any	VB.NET C# PHP	Java Python
Cloud Services And Tools	Amazon Elastic Compute Cloud(EC2) AWS	Windows Azure Platform Training Kit Windows Azure	Google Search Gmail Chrome Browser Google Maps	**Cloud Services And Tools**

	GovCloud(US) Amazon Relational Database Services(RDS)	Software Development kit Microsoft Visual Studio 2008 Service Pack 1		
Maximum Limits	Amazon S3- Store object up to 5 GB Amazon EC2 (Elastic Block Storage) (20 TB/account limit while in beta)	Azure has 64MB limit on individual blobs and also allows you to split a blob into blocks of 4 MB each	Automatic Scaling is built in with App Engine No matter how many users you have or how much data your application stores, App Engine can scale to meet your needs	**Maximum Limits**
Security	AWS network provides significant protection and also enables customers to implement further protection Uses SSL (encryption) to maintain confidentiality	Filtering Routers Firewalls Cryptographic Protection of messages Centralized monitoring, correlation and analysis systems Software Security Patch Management Network Segmentation Service Administration access Physical Security	Google's 2 step Verification	**Security**

VI. CONCLUSION

It has been concluded thatthe basic differences among these cloud computing servicesdepends upon thefacilities beingprovided by the Cloud Service Providers (CSPs). These facilities include storage space provided, computation power, platformsfor software distribution and online software applications from web-email to business analysis tools. A comparison of three service providers (Amazon AWS, Google App Engine and Microsoft Azure) also has been populated in the form of a table in this research paper. The information gathered in the research paper will help willing cloud users in taking significant decision to adopt cloud services according to their requirements as well as the services being provided by the cloud providers.

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